

SOME PEMPHIGINAE ATTACKING SPECIES OF POPULUS IN COLORADO.

(Concluded from Vol VI, p. 493.)

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Thecabius populiconduplifolius Cowen, Plate XV, Figures 1 to 9.

Pemphigus populiconduplifolius, Cowen, Hemiptera of Colorado, Bull. 31, Colo. Exp. Sta., p. 115, 1895. Hunter, Aphididæ of North America, p. 79, 1901. Gillette,* Jour. Economic Ent. p. 355, 1909. Jackson, Cols. Hort. Soc. Vol. 22, p. 217, 1908. Contributions No. 29, Dep. Zool. and Ent., O. S. U., p. 217, 1908.

Pemphigus ranunculi n. sp., Davidson, Jour. Economic Ent. p. 372, 1910.

Pemphigus populiconduplifolius, Davidson, Jour. Economic Ent. p. 374, 1910.

Pemphigus californicus, Davidson, Jour. of Economic Ent. p. 414, 1911.

Pemphigus populiconduplifolius, Essig, Pom. Jour. Ent. p. 699, 1912.

Pemphigus californicus, Essig, Pom. Jour. Ent. pp. 699, and 700, 1912. Essig, Pom. Jour. Ent. p. 827, 1912.

Pemphigus populiconduplifolius, Patch,* Bull. 213, Maine Exp. Sta. p. 76, 1913.

The above literature may be briefly summarized as follows:

The original description by Mr. Cowen dealt with the alate fundatrigenia in the folded leaves of the cottonwoods with the mere mention of yellow apterous individuals, all from Colorado.

Hunter lists this species only.

The writer, in 1909, recorded the species from Massachusetts.

Davidson, 1910, described the alate and apterous forms taken in California from the buttercup (*Ranunculus Californicus*) to which he gave the name *ranunculi*, but which is probably *populiconduplifolius*, as Mr. Bragg and Mr. Asa C. Maxson have repeatedly traced this species to the buttercup in Colorado, where it seems to be perfectly at home. On page 374 of the same paper Davidson records *populiconduplifolius* in the folded leaves of *Populus trichocarpa* and mentions seeing the stem mother.

*These can hardly be *populiconduplifolius*, as the stem females were reported in both cases as being present in the colonies of developing lice, a condition which we have never found in Colorado where the types of the species were taken. Furthermore, I have a stem female from Massachusetts that was taken by Mr. L. C. Bragg, and it is readily distinguishable from any of the stem females that I have seen from Colorado by having remarkably thickened femora for all legs. The femora are very nearly twice as great in diameter as they are in the Colorado form and are of about the same length. Four winged migrants taken from *Populus balsamifera* (Acc. No. 47-10) in Maine by Dr. Edith M. Patch are before me, mounted in balsam. These seem to differ from Colorado examples principally by having weaker sensoria, which are also fewer in number, on the sixth joint of the antennæ. I will suggest that this eastern form be known as *Thecabius patchii*, though it does not have the typical habit of most known examples of this genus of having the stem mother in a gall by herself.

Jackson merely quotes Cowen's original description.

Davidson, finding the name *ranunculi* preoccupied, suggests *californicus* instead.

Essig lists this species both as *populiconduplifolius* and *californicus*.

Dr. Patch records several captures of this species in Maine on the leaves of *Populus balsamifera* and gives a figure showing the distribution of the wax glands of what she took to be the stem mother, and also an excellent figure of the antenna of the alate fundatrix, or summer migrant.

This is a rather common but not abundant species in northern Colorado and the writer has also taken it at Wheatland, Wyoming, upon a broad-leaved cottonwood.

Fundatrix, Figures 1-4.

The general color of the fundatrix is yellowish olive green, lightest over the middle area of the abdomen, more or less covered with a white powdery secretion and a few wax threads about the lateral margins and posterior portions of the body; head, eyes, antennæ and legs, including coxæ, black or blackish; in general form, broad oval; eyes small but very prominent; length 3.75 to 4.50, and width 2.50 to 3.00; hind tibia, .60; length of antenna about .70; 5-jointed; joints I, II and IV subequal in length, the fourth being a trifle the shortest; joint III barely as long as IV and V together with the spur; spur about half as long as joint IV; only permanent sensoria present and they are bordered with cilia. The arrangement of the wax plates upon the head and thorax is shown in figure 3, and is about as follows:

Head with a pair of large circular plates on the vertex between the antennæ; on the occiput a similar pair, not quite so large but somewhat wider apart, and midway between these a smaller pair, rather close together; on the prothorax four large plates in a transverse row, and two small ones in front of the middle pair; meso- and meta-thorax and joints 1-6 of the abdomen, each with a transverse row of 6 plates; joint VII with 4 plates; joint VIII with 2, and none on joint IX. It is not uncommon for two of these plates next each other to coalesce and so reduce the number.

The fundatrix is never found in the leaves folded along the midrib in which the other lice occur, but is always found in a narrow fold on the margin of one of the first leaves to open and upon the under side, see figures 1 and 5a. The second generation, almost as soon as born, leave the pseudo-gall of the fundatrix and travel to the tenderest little opening leaves at the tip of the twig, where they locate, several to a leaf, upon the lower or ventral surfaces where they begin to feed, causing the

leaves to fold along the midrib as shown at figure 5, b. Mr. Maxson in a letter makes the following statement in regard to his observations upon the early occurrence of the second brood:

"The first larvæ of the second generation were observed June 18th. These were traced to the young leaves at the tips of the branches where they located on the underside. These leaves began to fold along the midrib and in a few days typical *P. conduplicifolius* galls were formed."

This second brood all acquire wings and leave the cottonwoods and go to the buttercups, *Ranunculus* sp., so far as our observations go. At the present writing, December 24th, there are several thrifty colonies in the laboratory on buttercups where they have been since the migrants were put upon the plants in July. They attack, not the roots, but the crown and leaves and stems near the ground. The buttercup seems to be a permanent food plant for this species, upon which it seems to be able to live continuously throughout the year.

COLLECTION DATA FOR FUNDATRIX.

Specimens in the collection have been taken as follows:

Ft. Collins, Colo.,	6-	2-13,	L. C. Bragg,	<i>Populus occidentalis</i>
"	"	"	6-12-13,	L. C. Bragg,
"	"	"	6-16-13,	L. C. Bragg,
"	"	"	6-20-13,	L. C. Bragg,
Denver, Colo.,		6-25-13,	L. C. Bragg,	

Fundatrigenia.

The winged fundatrigenia taken from the folded poplar leaves is the form described by Mr. J. H. Cowen in Bulletin 31 of the Colorado Experiment Station, page 115, as follows:

"Length 1.8 to 2.2 mm. Alar expanse 6.85 mm. Nearly black, pruinose. The abdomen is deep green when the glaucous matter is removed by placing the insect in alcohol. Antenna 1.00 mm. long, joints slender, 5th and 6th with about six or seven annulations each; stigma short and broad; unguis usually with a constricted neck. Similar to *ramulorum* but larger and the antennal joint not nearly so strongly annulated."

In addition it might be said that the transverse sensoria (Figure 7) are not complete rings, many of them extending but a short distance, and especially is this true on joint III; on joint IV the number commonly varies between five and eight, and the same is true of joint V, while the number on joint VI is usually six besides the terminal or permanent one; spur, finger-like and about .05 in length, or about one-half as long as joint II; joints I and II equal in length, the former cylindrical, the

latter larger at distal end, each measuring .07; near the proximal end of joint III on the front side is a short tooth or spine; wings (Figure 6) clear, veins slender, stigma rather small. Described from seven types on one slide taken at Boulder, Colorado, June 23, 1910, by Mr. L. C. Bragg, along with a large number of co-types.

COLLECTION DATA FOR FUNDATRIGENIA.

Ft. Collins, Colo.,	7-11-12,	L. C. Bragg,	<i>Populus</i> sp.		
"	"	"	8- 7-12,	L. C. Bragg,	" "
"	"	"	8- 6-12,	C. P. Gillette,	" "
"	"	"	7-12-13,	C. P. Gillette,	" "
Wheatland, Wyo.,	7-15-13,	C. P. Gillette,			" "
Boulder, Colo.,	6-23-10,	L. C. Bragg,			" "
Boulder, Colo.,	7- 4-11,	L. C. Bragg,			" "
Newcastle, Colo.,	7-23-93,	C. P. Gillette,			" "
Greeley, Colo.,	7-21-09,	C. P. Gillette,			" "
Lynn, Mass.,	6-27-09,	L. C. Bragg,			" "
La Salle, Colo.,	7-20-09,	C. P. Gillette,			" "
Eckert, Colo.,	6-26-10,	C. P. Gillette,			" "
Windsor, Colo.,	7-29-93,	C. P. Gillette,			" "
Niwot, Colo.,	7-15-08,	C. P. Gillette,			" "
Grand Jct., Colo.,	7-21-93,	C. P. Gillette,			" "
Veazie, Maine,	7- 5-10,	E. M. Patch,			" "
Delta, Colo.,	7-20-93,	C. P. Gillette,			" "
Niwot, Colo.,	7-15-08,	C. P. Gillette,			" "
Paonia, Colo.,	6-23-10,	C. P. Gillette,			" "

Mr. Maxson has given me the following statement in regard to the early appearance of the stem mother gall:

"The earliest date on which the galls were found was May 20th. On this date the lice were very small and appeared to be in the first stage after the egg, since no shed skins were to be found in the galls."

Alate Sexupara.

This form differs from the fundatrigenia by having joint II of the antenna (Figure 8) decidedly longer in proportion to its diameter; joint VI without transverse sensoria; joint V often without sensoria except the permanent one, but sometimes with one, two, or even three sensoria present; joint IV with but four or five sensoria, and joint V as long as joint VI with the spur.

This form has been taken at Fort Collins on several different dates during September on *Ranunculus* by Mr. Bragg, and about Longmont, Colorado, by Mr. Asa C. Maxson.*

*I am indebted to Mr. Maxson for the privilege of using the data that he has accumulated during the past two years from his studies of this insect. Mr. Maxson has also independently traced this insect to the *Ranunculus* from the cottonwood leaves.

Young larvæ.

The rather young larvæ of this species taken on *Ranunculus* are pale green in color and are heavily covered, especially over the abdomen, with fluffy wax threads. For full descriptions see Davidson's paper in Journal of Economic Entomology, 1910.

Pupæ on *Ranunculus*, pale yellow in color and very heavily covered with wax threads, especially over the abdomen.

Compared with Affinis.

This species is very close to *affinis* Kalt. of Europe, but seems to be distinct, and especially because of what seem to be rather marked differences in the antennæ. I have but a single European example of the alate fall migrant, sent me by Mr. J. J. Davis, from Dr. Tulgren, of Sweden.

I have found only six wax plates on the vertex of the fundatrix in twelve examples examined, while Tulgren gives eight for *affinis*; joint IV of the antenna is somewhat shorter in proportion to the other joints as compared with *affinis* in Tulgren's* figures, and joint V in the fall migrant commonly has two or three sensoria, while *affinis* is represented as having none.

Sexupara of affinis.

We have a good example of *affinis* from Europe, sent by Dr. P. van der Goot. Joints V of the antennæ have each one good transverse sensorium near the middle and one very small sensorium besides; joint IV has four well developed transverse sensoria on each antenna and is decidedly club shaped, being much heavier at the distal end. The same form of *conduplicifolius* has joint IV more nearly cylindrical and usually with four well developed transverse sensoria, joint V usually with none but sometimes with one or two small sensoria, and joint VI with none.

The antenna of the virgogenia seems to agree with that of *affinis* as figured by Tulgren.

Asiphum sacculi n. sp., Plate XV, Figures 10 to 14.

I first saw the gall of this louse about eighteen years ago when on a mountain trip some twenty miles or more northwest of Fort Collins. I did not meet with it again until the present summer, when, on July 13th, I found two of the leaf pockets characteristic of this species in Estes Park on twigs of *Populus tremuloides* about six miles apart and at an altitude of about

*Aphidologische Studien for Zoologi, 1905, Band 5, No. 14.

7500 feet. On August 9th, four more of the galls were taken near the Half-way House on Pike's Peak, at an altitude of about 9000 feet. In two of these galls there were no living lice. In each of the occupied galls taken (four), there was one large stem-female present, with a large number of her offspring in all stages of development up to the adult alate lice. There were no adult apterous lice and all that were half grown or more gave evidence that they were to get wings. In the breeding cages the alate lice began at once to deposit young with long beaks. In every case the lice were accompanied by a species of large black ant.

The Gall. An infested leaf becomes very much enlarged, and somewhat thickened with the edges turned in so as to make a heart shaped pocket, and the apex of the leaf is extended and turned back as shown in Plate XV, Figure 10. The color of the infested leaf is yellowish green, and lighter than the healthy foliage surrounding it.

Fundatrix. Figures 11 and 13.

A very large, oval, slaty gray louse, lightly covered with a fine white powder, and set everywhere with delicate gray hairs above and below; length of body about 4.50; width 4.00; antenna, .75; joint III longest and almost as long as joints IV and V together; permanent sensoria ciliated, joints I, II, and III with numerous delicate hairs; beak barely attaining third coxæ; hind femur .80; hind tibia .80.

Pupa. Figure 12.

The pupæ are quite dark in color, the abdomen being very dark olive green and the head and thorax a rather blue slated gray; the tarsi, eyes and terminal joints of the antennæ black. A conspicuous marking of the larvæ and pupæ consists of a row of five tufts of white waxy secretion along either lateral margin of the abdomen.

Fundatrigenia.

All the young of the fundatrix, the second generation, become winged and leave the galls. General appearance, that of a black louse; abdomen olive green; thorax, head, and antennæ blackish, or dusky; legs yellowish; tarsi dusky; wings a trifle smoky; the veins slender with a narrow dusky line on either side; stigma narrow, lanceolate, dusky, fork rising about midway on the cubital vein; length of body 3.50; wing 4.50; antenna (Figure 14) 1.00; joint III with 7 to 9 oval sensoria and a well developed spur near the base; joint IV, with two similar sensoria near the distal end; joints V and VI with the usual permanent sensoria only which are ciliated about the margins; joint III longest, fully as long as joint VI with the spur; joint V slightly longer than joint IV; cauda a broadly rounded lobe.

Habits for the remainder of the year unknown.

Mordwilkoja vagabunda Walsh,* Plate I, Figures 15 to 20.

Byrsocrypta vagabunda Walsh, Proc. Ent. Soc. Pha., V. I, p. 306, 1862.

Pemphigus vagabundus, Walsh and Riley, Am. Ent. V. I, pp. 57 and 107, 1869; Riley, V. I, Mo. Rep. p. 120, 1869; Packard, Guide to Study of Insects, p. 524, 2nd. Ed. 1870; Thomas, Ent. Rep. Ill., V. I, p. 153, 1880; Oestlund, Aphids Minn. p. 22, 1887; Packard, Forest Insects, p. 434, 1890; Osborn, Cat. Hemip. Ia. p. 130, 1892; Cowen, Bull. 31, Colo. Exp. Sta. p. 116, 1895; Hunter, Aphid. of N. A., p. 79, 1901; Cook, O. Nat. V. IV, p. 118, 1904.

Pemphigus oestlundii n. sp., Cockerell, Ent. News, p. 34, 1906.

Pemphigus vagabundus, Jackson, Genus Pemphigus, Cols. Hort. Soc. XXII, p. 200, 1908.

Mordwilkoja oestlundii, Davis, William's Aphididae of Neb. p. 4, 1911; Patch, Bull. 213, Me. Exp. Sta. p. 100, 1913.

The galls of this louse at the terminal buds of cottonwood twigs have occurred in greater or less abundance in at least one limited locality near Fort Collins, Colorado, for the past fifteen or more years. The section referred to is mostly rather low, moist land, along the course of an irrigating ditch and near the river. It seems strange that the galls should not have become more generally distributed unless the alternate host is largely limited to the area mentioned. I am assuming that there is an alternate host for the reason that the lice all become winged and leave the galls rather early in the summer. Most of them are gone by August 1st here.

The Galls, Figures 18, 19 and 20.

When growing, the galls are as green in color as the cottonwood leaves, and are, in fact, a transformed leaf in each case. On the inside of the green gall the main veins of the leaf are very prominent. Apparently these galls differ from others produced by Aphids by not having any opening to the exterior during their growth, but Mr. L. C. Bragg has discovered a small brown scale (Figure 18 A, and 20, b) at the base of the gall, which seems to be the apex of a folded leaf, beneath which is an opening to the interior and through which the blade of a penknife may be passed without cutting any tissue. This opening is so narrow that the lice do not escape by it. About the time that fully matured winged lice are developed in a gall (about July 10th to 15th,

*Professor Oestlund, in his Aphididae of Minnesota, p. 22, states that Walsh's *vagabundus* is evidently something different from the louse that has since been known to be associated with the coxcomb gall. To be sure, September is late to take the migrants from these galls, and the measurements given by Walsh are too large for this species. But he evidently had a louse belonging to the Genus *Pemphigus*, as then understood, and in the Walsh-Riley paper published in Vol. I, of American Etomologist, page 107, the vagabond gall was figured, and both the winged lice and the apterous stem mothers from the galls mentioned. As Walsh at that time considered the winged lice from these galls the same as what he had described as *B. vagabunda*, it seems to me best to abide by his identification of his own species, and especially as we do not know any other species to which to refer his original description, which is quite inadequate for its identification anyway. I am therefore retaining the name *vagabunda*.

at Fort Collins), little star-shaped mouths (Figures 18 and 19, o) appear at the apices of the more prominent lobes thru which the alate lice escape. Many of them appear on a single gall as shown in Figure 18. The galls nearly always are from terminal buds, and whether one or more of the leaves form a single gall I have no certain knowledge, but apparently it is one in each case. Large galls measure as much as 80 to 95 mm. in greatest diameter, and about 50 to 60 in the greatest thickness.

The Fundatrix. Figures 15 and 16.

One fundatrix was found in every gall opened. General color of body yellowish green, the yellow tinge seeming to come from a large number of small embryos within; nearly unicolorous throughout, but a little darker along the lateral margins; legs and antennæ yellowish, the antenna blackish at tip; both antennæ and legs very short; joints of antenna 4; joint III about one-half the entire antenna in length; spur two-thirds as long as joint IV; permanent sensoria ciliated.

Length of body 5; width 3.70; constricted a little at base of abdomen. In general, stout, pear-shaped, the small end being at the head; covered everywhere with a light covering of white powder.

Young lice and pupæ in the galls are very pale yellowish and much powdered. There are a great number, possibly a thousand in all, in a gall and apparently the stem females were just in their prime and packed full of embryos on July 11. All of the offspring get wings when adult.

Fundatrigenia, Figure 17.

All alate lice with black head thorax and antennæ, and dark green abdomens, and the thorax and abdomen are heavily pruinose with more or less cottony threads towards tip of abdomen, making a tuft. Length of body 2.50 to 3.00 mm.; antenna .85; joint III as long as joints IV, V and VI to base of spur; joints IV and V sub-equal; spur about equal to joints IV and V together; a distinct spur near the base of joint III; sensoria on transverse ridges, but not surrounding the joints; joint III with nine to eleven sensoria; joint IV, two; joints V and VI with permanent sensoria, only; spur with two or three sensoria, usually three, scattered along its length; cauda very small, rounded.

Described from lice escaping from the galls July 11, 1913.

